$a_H = \frac{h^3}{4\pi^2 e^2 m}$ (a_H = radius of the electron in the normal state).

$$= 0{\cdot}532 \times 10^{-8} \text{ cm.}$$

and

$\frac{e^2}{2a_H} = e(13{\cdot}54 \text{ volts})$. Therefore for an element x with an ionisation potential of V_x we have

$$a_x = \frac{(0{\cdot}532 \times 13{\cdot}56)}{V_x} \times 10^{-8} \text{ cm.}$$

Thus *the atomic radius varies inversely as the ionisation potential.*

The atomic radii calculated according to this formula are, in general, smaller than the atomic radii calculated either from crystal data (Bragg) or from the kinetic theory of gases (Rankine and others). They are shown in the appended table for the sake of comparison :—

Atomic Radius.

Element	I.P.	From I.P. $a \times 10^8$	Crystal measures $b \times 10^8$	Viscosity data
H	13·54	0·530	—	—
He	25·40	0·28	—	1·08
Ne	22·80	0·33	0·65	1·01
(Horton, *Phil. Mag.*, May, 1921)				
Li	5·40	1·34	1·50	—
Na	5·11	1·41	1·77	—
K	4·32	1·67	2·07	—
Rb	4·16	1·73	2·25	—
Cs	3·88	1·86	2·37	—
Cu	7·63	0·94	1·37	—
Ag	7·50	0·95	1·77	—
Au	8·63	0·83	—	—
Mg	7·61	0·95	1·42	—
Ca	6·09	1·18	1·70	—
Sr	5·67	1·27	1·95	—
Ba	5·19	1·39	2·10	—
Zn	9·35	0·77	1·32	—
Cd	8·95	0·81	1·60	—
Hg	10·38	0·69	—	—
Tl	7·30	0·99	2·25	—
Mn	7·38	0·98	1·47	—

The values of V_x for copper, silver, and gold have been calculated from Hicks's value of the (1S) term for these elements. That for manganese has been similarly calculated from Mr. Catalan's value of (1S) for manganese (not yet published). For these data I wish here to record my indebtedness to Prof. Fowler and Mr. Catalan. The sources for the other values are quite well known. MEGH NAD SAHA.

21 Cromwell Road, London, July 13.

American and British Superannuation Systems.

I READ with great interest the article in NATURE of June 30 on the American and British superannuation systems. The selection of a satisfactory scheme of superannuation is a matter of great importance in the organisation of a public service. On the one hand, an age limit can be effectively enforced only when suitable provision is made for those who are forced to retire, and on the other the provision of a pension conditional on the completion of a full term of service is objectionable, because a public servant who retires before that period is completed is penalised by the loss of a portion of the consideration for which he has given his labour. The result is that although a man may feel that he would do better work in another sphere, and has an opportunity of doing so, he cannot bring himself to forgo the pension towards which he has already contributed some years of service.

The recent Committee of the British Science Guild on the Utilisation of Science in Public Departments considered this question, and came to the conclusion (Journ. Br. Sci. Gd., June, 1921, p. 37) that the best solution appeared to be to award at the end of every year's service a pension (or alternatively an endowment insurance) accruing at the age fixed for superannuation (or in the case of the insurance at that age or previous death), independently of whether the officer had remained in the service or not. The advantages accruing in respect of a single year's service would, of course, be comparatively small, but those for successive years would, when added together, furnish an adequate provision for the old age of officials who had served the full term, while they would be a welcome addition to the resources of those whose later careers had followed other directions.

It is essential that these benefits should be secured by public funds, and based on actuarial calculations at current rates of interest. The amounts now quoted by insurance companies are apparently calculated on pre-war rates, and are far too low.

This scheme could be adopted whether the basis of the superannuation were contributory or not.

July 19. JOHN W. EVANS.

MAY I point out, in connection with the note appended to my letter printed in NATURE of July 21, p. 651, that if only one mutual life assurance company were available the argument quoted in the leading article of June 30 would be answered, for that argument implied that dividends necessarily go to shareholders? The remark about expenses in the note leaves the point of paragraph (3) of my letter untouched, and the final sentence of the note makes me wonder whether the two-year-old American "Teachers' Insurance and Annuity Association " will grow up and prove itself to be more "philanthropic" than the selected assurance companies in England.

I am afraid that, quite unintentionally, my former letter must have seemed offensive to have justified your note to it. The hot, dry weather has been, and still is, trying to us all, *et tout comprendre c'est tout pardonner!* W. PALIN ELDERTON.

July 22.

A Novel Magneto-Optical Effect.

IN connection with the very interesting observations communicated by Dr. R. Whytlaw-Gray and Mr. J. B. Speakman (NATURE, July 14, p. 619), I should like to point out the close similarity of the phenomena which they have observed with those observed in the case of soap solutions (Proc. Roy Soc., A, 1921, vol. xcviii., p. 395; and Journ. Chem. Soc., 1920, vol. cxvii., p. 1506).

Gray and Speakman describe the formation of flexible strings or fibres in clouds of various metallic oxides, these fibres being made up of particles of colloidal dimensions which still retain their individuality. Miss Laing, in her study of gelatinisation, was led to the conclusion that such conjunction or orientation of colloidal particles forms the mechanism of gelatinisation. For instance, in a soap solution the individual colloidal particles are otherwise the same in the liquid sol as they are in the elastic jelly. In the letter referred to it is pointed out that the particles in a cloud of cadmium oxide have an exceptional tendency to form such strings, and this agrees with the striking behaviour of Svedberg's sols of the same substance in alcohol, which on standing gelatinise, but on slight shaking revert to the fluid condition, an alternation which can be indefinitely repeated.

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Gray and Speakman's results are of special interest because they occur in a particularly simple system, and thus afford opportunity for studying the mechanism of this effect, which, if Miss Laing's hypothesis is correct, must account for gelatinisation, even in the most complicated systems. J. W. McBAIN.

University of Bristol, July 19.

Science and Civilisation.

CAPT. B. J. MARDEN'S letter in NATURE of July 14 (p. 623) raises a question which must be exercising the minds of many of the readers of NATURE to-day. That question is: How can scientific workers collectively obtain such control of the product of their work—new knowledge—as to secure that it shall be used for the development of a better order of society out of the existing chaos? Science—knowledge—alone can create this new order and save Europe from relapsing into barbarism. If this be accepted as a true statement of fact, we are led naturally to inquire: What are the best methods to pursue to secure that science shall be so applied?

The time is now ripe for scientific workers to set to work to devise a practicable scheme which will give to science its proper place in shaping the future destinies of the world. This is one of the chief purposes for which the National Union of Scientific Workers exists. Capt. Marden's idea seems to involve a sort of international Syndicalism applied to scientific workers and to scientific work. (Those readers who know about Syndicalism only from the daily Press will find a clear exposition of the Syndicalist position in Mr. Bertrand Russell's "Roads to Freedom," chap. iii., Geo. Allen and Unwin, 3*s.* 6*d.*) Such an organisation would offer no adequate security against the tyranny of a group over the rest of the community; and a dictatorship of scientific workers might be almost as great an evil as a dictatorship of miners, or of food producers, or of financiers. We should like to urge Capt. Marden and others who may have thought out schemes for the proper utilisation of science for the salvaging of what is worth preserving in our civilisation, and particularly those who have thought them out in the light of the large and growing volume of literature on the problem of the *rôle* of the producer (whether a producer of knowledge or of other essentials) in the future society, to publish their ideas in detail.

J. HENDERSON SMITH,
Chairman of Executive.
A. G. CHURCH,
Secretary.

National Union of Scientific Workers,
25 Victoria Street, Westminster,
S.W.1, July 19.

Bees and Scarlet-Runner Beans.

IN NATURE of August 12, 1920 (vol. cv., p. 742), a letter was published from me on the behaviour of bees visiting the flowers of the runner bean, *Phasiolus multiflorus,* to the effect that almost invariably the nectar was obtained from the flower by penetrating the calyx and corolla close to the position of the nectaries, the humble bees with their stronger mandibles biting through the sepals, while the honey bees took advantage of this pioneer work of their stronger relatives.

To my surprise, this year I find no such depredations made on the blossoms, but all the numerous humble bees are getting the nectar in a legitimate way, that apparently indicated by Nature, viz. by clinging to the more open left side of the flower and intruding the proboscis beside the pistil and stamens down to the nectar at the base of the petals. No honey bees have yet been seen on the flowers, but whether because of their scarcity or by reason of their being now unable to reach the honey is not clear.

As the jasmine flower is still bitten by the humble bees, it would appear that the hot and dry season has caused the change in the behaviour of the bees towards the bean flower, probably by hardening the calyx and making it more difficult to penetrate, while causing the bloom to be less in size and depth, so that the nectar can be more easily reached from a frontal approach. HARFORD J. LOWE.

Torquay.

A New Theorem on the Double Pendulum.

THE following interesting relation is believed to be new:—

Let M and m be the masses of the bobs of a double pendulum, and let A and B be their respective amplitudes with suffixes 1 and 2 to denote the modes. Then

$$\frac{A_1A_2}{B_1B_2}=\frac{-m}{M}.$$

The negative sign merely indicates that in one mode the bobs are opposed, and it may therefore be ignored if the absolute values of the amplitudes are considered.

It is noteworthy that the product of the amplitude ratios is inversely as the mass ratio—that is, directly as the respective distances of the bobs from their centre of gravity. It is striking that the product of the amplitude ratios is independent of the lengths of the pendulums, *i.e.* independent of the relative position of the bobs and the point of support.

When the bobs are of equal mass it follows from the foregoing that the lower pendulum is divided by the vertical through the point of support into segments the ratio of which in one mode is the reciprocal of the ratio in the other mode, *i.e.* if one point of section be obverted or swung about the middle of the lower pendulum through 180°, the two bobs and the two points of section then form a harmonic range which has many well-known properties.

H. S. ROWELL.

15 Bolton Road, Chiswick, W.4, July 18.

Ochreous Flint Artefacts from Sheringham.

I HAVE recently paid another visit to Sheringham, and have again devoted my attention to the ferruginous "pan" which, for a distance of more than a quarter of a mile, is exposed in places in the base of the cliff forming Beeston Hill. From different areas of this "pan" I have taken fifteen more examples of the ochreous flints such as occur upon the foreshore exposed at low water. The specimens, as would have been clear to anyone examining the deposit intelligently, were, without question, *in situ,* and were embedded prior to the deposition of the great masses of glacial and other strata of which the cliff is composed. J. REID MOIR.

One House, Ipswich, July 22.

The Drought and Underground Water.

THE present drought affords an excellent opportunity for studying natural underground drainage in limestone (including chalk) districts. In many streams part of the flow takes place underground, but the fact cannot readily be ascertained while a surface flow continues. The flow of small streams is now so much reduced that the whole stream may be swallowed in the limestone and may reappear lower down. It is to be hoped that geologists in limestone districts will seize this opportunity to make observations. BERNARD HOBSON.

Thornton, Hallamgate Road, Sheffield,
July 22.

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